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Improving the Quality of Undergraduate and Company Interactions in Process Safety

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Abstract

There are many different elements an undergraduate student needs to learn to become an engineer. These range from basic chemistry to fundamental engineering principles and process safety. But a key aspect of the education is interaction with facilities and future employers. This interaction can be achieved via a number of ways, with the most intensive being intern employment ranging to the least intensive consisting of facility tours. As part of a project to improve the overall process safety education for engineering undergraduates, the IChemE Safety Centre has been exploring specific guidance to help focus the interactions regarding process safety to achieve greater value from them. This includes aspects like establishing a criteria for what students should be seeking information on as well as what companies should be seeking to provide. This paper will explore this criteria and challenge companies and academics to apply this with students.

Introduction

Studying engineering at university is an intensive program, and one of the longest bachelor's degrees. During this time of between four and five years studying, there needs to be opportunities for the students to interact with industry and gain valuable experience in the workplace. This is because the academic setting and the industry setting are significantly different and they typically work on different priorities and timelines. In the past in Australia, at the end of year three, students would seek work experience for approximately 12 weeks usually over the summer period. Given by this stage they have some engineering fundamentals, they can contribute effectively to the organisation, but also learn a great deal about the industrial environment. When they return to complete the fourth and or fifth year, they do so with some experience, which can enhance their experience as they have learnt to translate their academic information into industrial applications.

What is the problem?

Sadly, over time, these experiences have become less prevalent, with students struggling to find the work placement. Anecdotal information from a university suggested approximately only 60% of their students were achieving placements. There may be several reasons for this, and this paper is not intended to discuss these reasons, other than to suggest that the opportunities offered by companies have decreased, making it more difficult. It is then important for companies to recognise that they have a place in providing these opportunities to have a chance of getting better rounded and experienced graduates to employ. It is now possible for students to graduate and enter the workforce having never seen a process plant.

While the lack of experience leading into the final years of education is a challenge for the engineering development of the student, it also results in reduced opportunities for students to experience process safety in an operational sense.

Without any operational experience while a student, there is a chance that when they enter the industry as a graduate they do not understand the importance of operational process safety. For example, if their first experience of a permit to work system is when they have been stopped from doing a task and sent to get approvals, this can set a tone that safety systems just "get in the way of doing the job". While this may be an oversimplification, the smallest issues can shape a person's perspective and create a culture that may not be optimal.

When interaction does occur, it is often less structured. A student may receive a tour of a facility where they are shown the different units and have a chance to ask questions. This shows what a facility looks like but does not explain how it operates from the people perspective. Or during placement a student may be given a project to work on, varying from an actual engineering task involving working with others, to a mundane task of processing and filing paper work. Obviously the more the task focuses on engineering work the better the experience will be for all the parties.

A possible solution

There are multiple aspects to the possible solution. First, more opportunities for placement activities is required, however that is not the point of this paper. There also exists other opportunities for students to interact with industry facilities to gain some degree of experience, such as detailed site tours. Again, it would be useful to see more of this occur, but that is not the point of this paper. This paper focuses on how to improve any interaction that does occur by providing a structure that highlights the place process safety plays in an organisation. Process safety in any high hazard organisation should be an integral way of doing business. This means that a great deal can be learnt about an operation by asking about process safety. This is because the discussion will venture into elements of operational control, allowing the knowledge transfer about the process as well as the safety.

It should be noted that the responsibility for a positive interaction between student and industry rests with both parties. Students have an obligation to seek information and ask questions and industry needs to have a will to show students different aspects and answer the questions asked. It is important to understand that the first interaction between students and a particular facility is likely to be the site induction. This is a great opportunity to show case some of the process safety processes at a facility as well as an opportunity to ask questions.

What are the key topics?

There are several areas that the student and industry should engage in. As discusses above, several of these can be introduced in a facility induction, but others require more targeted questions. Considering the key element is to show and learn about operational process safety in an industrial setting focuses the questions to the types of interactions. Such interactions include:

- Discussion on key hazards at the facility
- Discussion of the controls implemented to manage these hazards
- Understanding the role of the student during their time at the facility – is it is tour or an internship, as well as what activities the student will undertake and understanding the role of the supervisor at the facility
- Understanding the emergency response requirements and the student's role in these
- Use of the permit to work system
- Use of the management of change system
- How the incident reporting and investigation process works
- How the safety management system is structured and their role within in it
- How safety is measured on the site with respect to metrics or indicators
- How integrity of equipment is maintained
- Operational parameters

What should students be asking and what should industry be sharing?

Each of the items listed above have a different perspective depending on whether it is the student asking or the industry sharing. Table 1 highlights key considerations from each perspective. This is not an exhaustive list, but some initial ideas on interaction.

Topic	**Industry**	**Student**
Key hazards	Site hazards should be presented as part of any induction, however for engineering students, extra information should be shared, such as how they hazards were assessed and how decision were made on their management.	The student should seek out information on the site hazards, such as chemical properties, so they are informed and able to ask about specific details of the properties and how it is managed.
Controls	The philosophy behind the selected and rejected controls should be discussed. This would include how they are maintained to ensure they function as intended. This detail may be found in the	This follows on from the hazards, for example if a hazard is flammable gas, how is the atmosphere monitored, where are gas detectors located and how do they function. If there are reaction hazards, how is the

	Process Hazards Analysis or Safety Case Report.	reaction started, how can the reaction be controlled or terminated?
Role clarification	It should be clear to the student what role they have in the current interaction and therefore what obligations they have with that position. It should also be clear how that role fits in with the rest of the organisation.	Students should seek to understand how the role that are fulfilling impacts on the safety of the facility (or not) and how it interacts with others in the organisation.
Emergency response	In addition to basic induction information on what to do in an emergency, students should also be taught about why specific scenarios for emergency planning were selected and how the process is developed.	Students should ask about how the emergency response plans are developed and how the hazards and controls feed into the plans. They should also ensure they are fully aware of their role in an emergency and be able to exercise that role confidently, even if it is just to muster.
Permit to work system	Students should be introduced to the facility permit to work system and its requirements, especially if they will need to be a permit holder at some point.	Students should ask about when a permit is required and how the process is managed, including what isolations and risk assessments are required and who has authority to approve a permit.
Management of change	Students should be introduced to the facility management of change system and its requirements, especially if they will need to be involved in a change at some point. This should include the requirements for management of change to be closed out.	Students should ask about when a management of change is required and how the process is managed, including what risk assessments are required and who has authority to approve the change. This should include the requirements for management of change to be closed out.
Incident reporting and investigation	Students should be informed of the need to report incidents and how to do as, as well as an overview of	Students should seek to understand the different incident classifications and in particular how process

	what the investigation process involves. This should be a standard part of any induction.	safety events are managed. They should also look to understand more about the investigation process works and if possible sit in on some investigations during internships.
Safety management system (SMS)	An induction should cover the overarching aspects of the SMS including the policy and how it is structured.	Students should ask about how different elements of the SMS fit together and what their role is in supporting the SMS during internships.
Metrics or indicators	The facility should inform students that that do measure performance via a variety of means including lead and lag indicators. It can also be helpful explain how the indicators are calculated and reported.	Students should ask about which indicators they have can an impact on and how.
Integrity management	Integrity management is a critical part of process safety but is often not mentioned in inductions. Information on the integrity philosophy should be shared with the students when they are on an internship so they understand how the plant is kept functioning safety.	Students should ask about how the integrity management is managed and what sort of preventative maintenance in undertaken, as well as how this is scheduled and monitored.
Operational parameters	This is an area not typically covered in inductions. The operational philosophy should be shared, including how the operational envelop is defined and monitored, and what the escalation levels are.	Students should ask about how the operational parameters are defined and monitored, as well as what occurs when they are exceeded. This is both from a response perspective as well as an investigation perspective.

Table 1: Key considerations

Further work

This paper outlines topic areas for conversation led both by students and industry. This information needs to be further defined into useful examples of the interactions and the information. The IChemE Safety Centre will continue to develop this concept and produce a

detailed resource aimed at students and one aimed at industry to help them focus their interactions to get better process safety outcomes. It is anticipated these resources will be published in 2019.

Conclusion

A fundamental part of an engineering education is a positive interaction with industry to show application of the topics studies. Without this interaction, the learning can sometimes be too theoretical. Industry do need to offer more opportunities for workplace interaction with students, but we also need to ensure that we can get the most value from any interaction that occurs. Simply increasing the number of interactions but having them low value will do very little to enhance the education of our future engineers. We need both industry and students willing to seek out high value interactions to maximise learnings and better develop our future generations of engineers to achieve improved process safety outcomes in the future.